Middle Eel River

Watershed Management Plan

SECTION 4

PROBABLE CAUSES OF WATER QUALITY IMPAIRMENTS

1/6/11

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4.0 Probable Causes of Water Quality Impairments

The 2009 and 2010 water monitoring (Section 3) revealed that the major contaminants in the Middle Eel River Watershed are TSS, *E. coli* and nutrients (nitrogen and phosphorus). Since 89% of land use in the watershed is agricultural, it is most likely that agricultural practices are a main source for these pollutants getting into the Eel River and its tributaries. The National Water Quality Inventory (U.S. Environmental Protection Agency – Office of Water 2009) reported that agriculture is the leading source of degradation of our rivers and streams. According to the Inventory, agricultural activities that may result in nonpoint source pollution include animal feeding operations, grazing, plowing, pesticide spraying, irrigation, fertilizing, planting and harvesting.

TSS, total suspended sediment is the single largest (by volume) nonpoint source contaminant in the watershed. The fact is that if soil could be kept out of the water, many water quality problems would improve. Indiana State Department of Agriculture tracks the tillage practices by county in Indiana. Using these numbers, it is estimated that in 2009 approximately 30,000 acres of conventionally tilled corn and approximately 7,000 acres of conventionally tilled soybeans. Conventional tillage leaves the soil exposed from harvest to plant sprouting (approximately 5 months); exposed soil can be affected by wind and water erosion contributing to TSS in the water. With approximately 37,000 acres of bare ground for about 5 months of the year, it is likely that conventional tillage is a major contributor to the extremely high TSS within the watershed. Other contaminants move with soil particles such as phosphorus which binds and moves with clay particles, nitrates and *E. coli* that are present in animal wastes that are land applied as fertilizer may runoff fields with unprotected soil during rain events or snow melt. A likely source of soil in the water is erosion, from both conventional row crop agriculture and stream-bank erosion.

By comparing discharge to TSS, Figures 4.1 and 4.2, it is clear there is a very strong correlation between discharge and TSS. This suggests that field erosion and run-off caused by rain events within the watershed are a major contributing factor to high levels of TSS in the watershed.

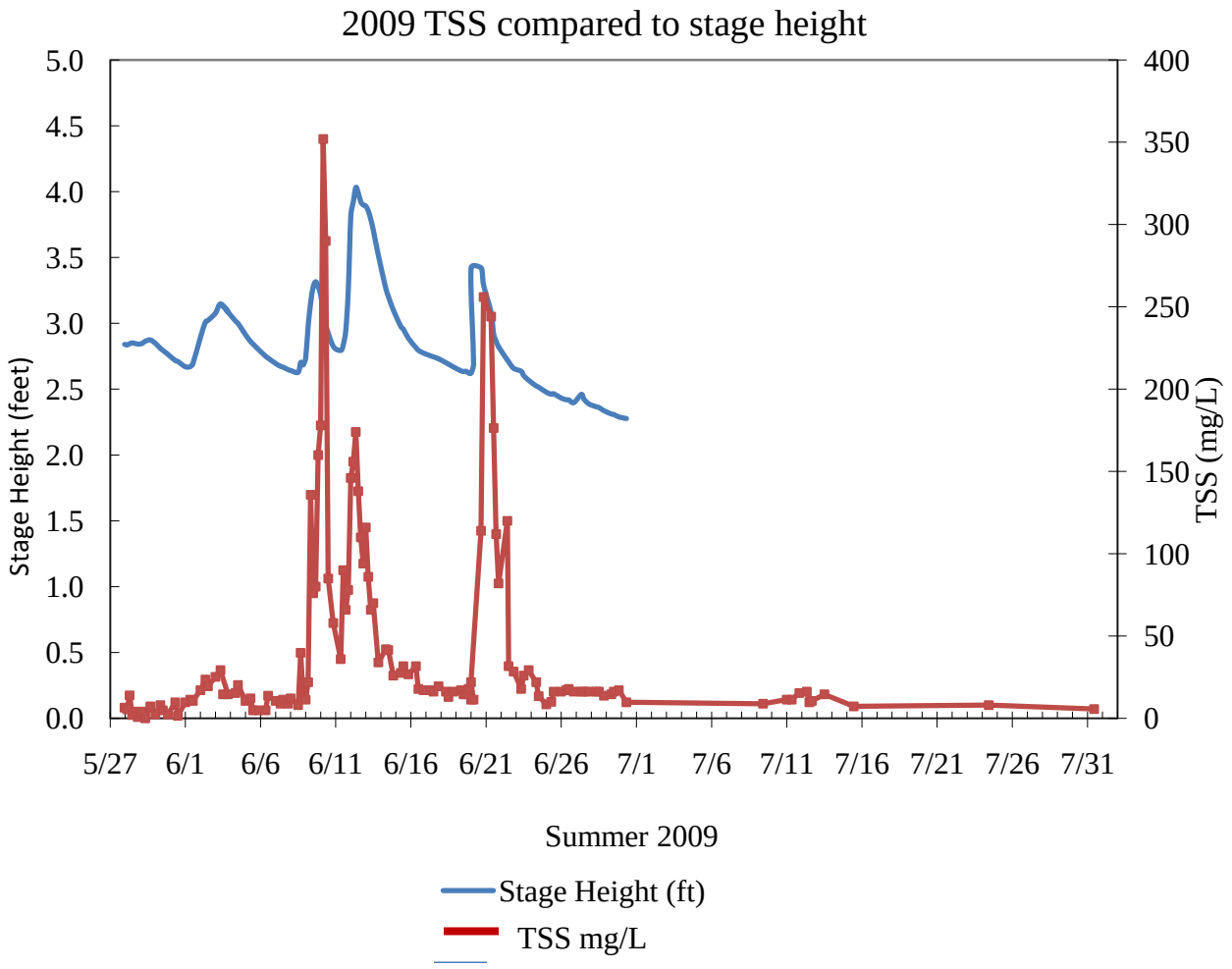

Figure 4-1. Middle Eel River Watershed – Blocher Gage 2009 TSS results compared to stage height at North Manchester.

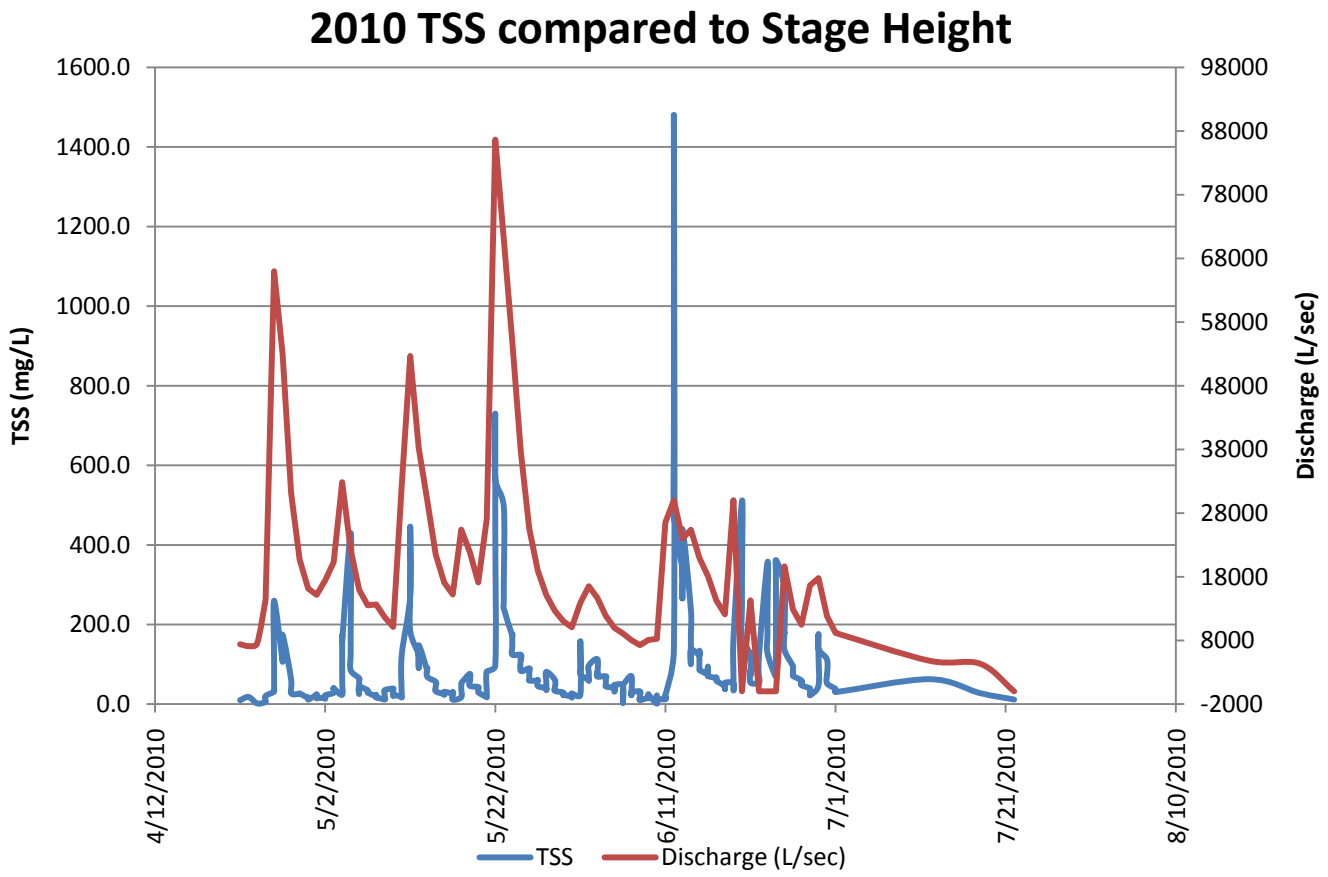

Figure 4-2. Middle Eel River Watershed – Blocher Gage 2010 TSS results compared to discharge in L/sec at North Manchester.

E. coli is the main cause for stream lengths in the Middle Eel River Watershed being included on IDEMs 303d List of Impaired Waters and was identified as a major contaminant during water monitoring in 2009 and 2010 (Section 3, Tables 3-7 through 3-11). Water monitoring indicates that E. coli increases dramatically with rain events which may be due to animal feed operation runoff, accidents (hose ruptures, spills, etc), combined sewer overflows, livestock having direct access to streams, and improper application of manure. Pollutants in animal waste can impact waters through several possible pathways, including surface runoff and erosion, direct discharges to surface waters, spills, and leaching into soil and groundwater.

Nutrients, specifically nitrogen and phosphorus, are also a cause for stream lengths within the Middle Eel River Watershed being included on the IDEM 303d List of Impaired Waters. Excess nutrients cause algal blooms which may result in hypoxic (low oxygen) zones that have a negative effect on wildlife and their habitat as well as effecting the recreational use of water by humans. The probable sources of high nitrogen and phosphorus within the watershed are: improper or over application of nutrients including manure and synthetic fertilizers, erosion

due to conventional tillage, agricultural tile drainage, livestock access to the stream, animal feedlot run-off, and combined sewer overflows (CSOs).

By comparing stage height to Total Phosphorus, Figures 4.3 and 4.4, it is clear that there is a strong correlation between discharge and Total Phosphorus. This suggests that a large contributing factor to elevated Total Phosphorus is field erosion and run-off caused by rain events.

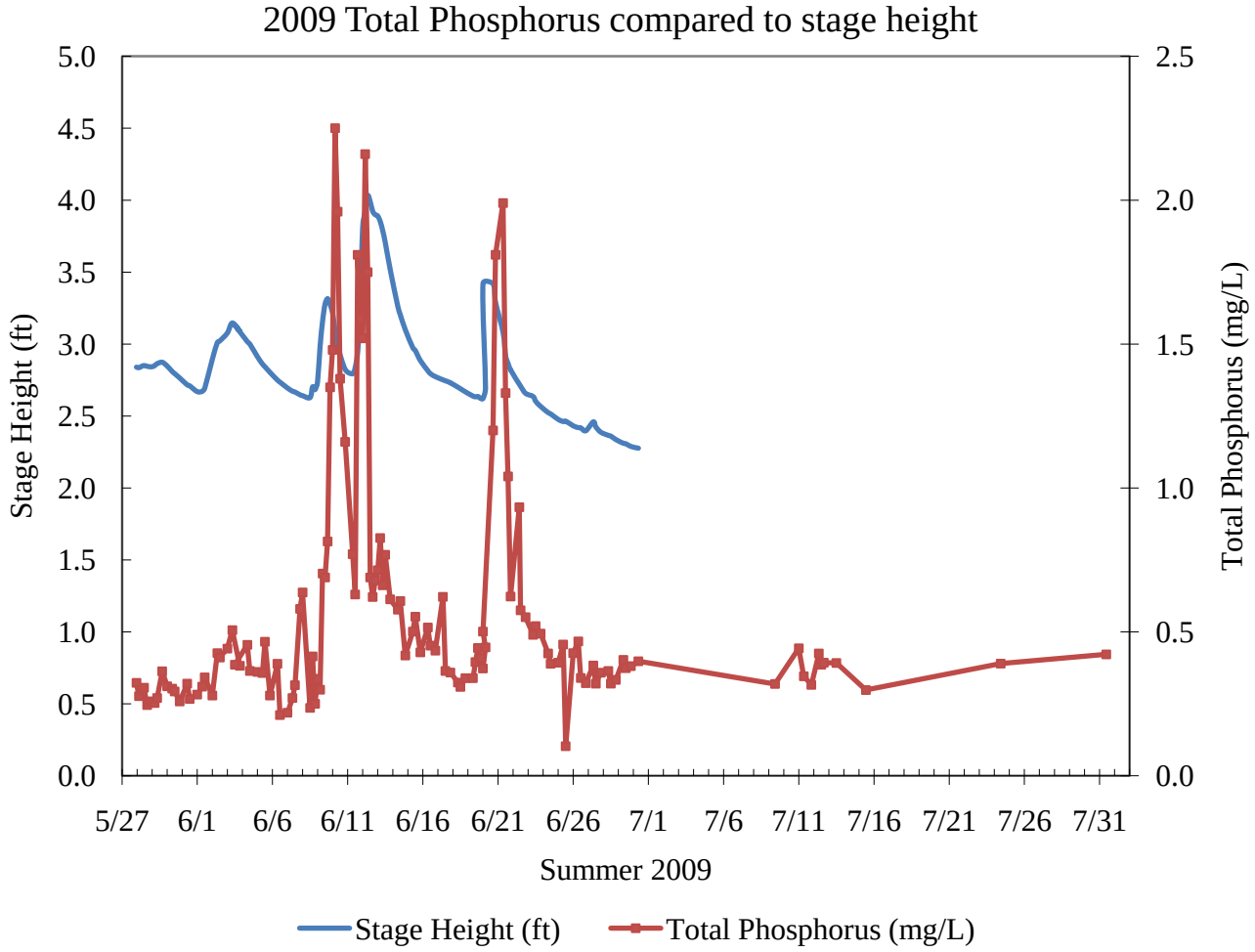

Figure 4-3. Middle Eel River Watershed – Blocher Gage 2009 Total Phosphorus results compared to Stage Height at North Manchester.

In addition to the chemical water quality monitoring, biological studies such as the IBI (Index of Biotic Integrity) has shown impaired biotic communities within the Middle Eel River Watershed (Section 3, Figures 3-16 and 3-17). Impaired biotic community is a cause for stream lengths within the watershed being included on the IDEM 303d List of Impaired Waters. Probable causes of low IBI scores are in-stream habitat degradation, land use changes in the riparian zone, and poor water quality. QHEI (Qualitative Habitat Evaluation Index) has indicated poor habitat availability within the watershed (Section 3, Figures 3-14

and 3-15). Probable causes are substrate degradation, hydrologic modifications and land use changes.

Mercury and PCBs in fish tissue is also cause for stream lengths being on the IDEM 303d List however this problem is beyond the scope of this project.

Potential water quality stressors, sources and causes of excessive nutrients (nitrogen and phosphorus) in tributaries and mainstem	
Potential Source	Basis/Evidence
Tile drainage discharge	Increased nitrogen and phosphorus may be coming from tile drains. Concern for tile drainage was voiced at Steering Committee Meetings. Tile drainage occurs in almost every field throughout the watershed and is likely a source of excess nitrogen and phosphorus entering the stream.
Erosion from cropland	Increased sediment, carrying nutrients, could be coming from agricultural land use. Concern for agricultural land use contributing to high nitrogen and phosphorus was voiced at Steering Committee meetings. 89% of land use within the Middle Eel River Watershed is agricultural and Miami and Wabash County have approximately 37,000 acres of land in conventional tillage.
Fertilizer and manure runoff	Increased nutrient levels could be coming from agricultural operations. Concern for agricultural land use contributing to increased nutrient load was voiced at Steering Committee Meetings and Public Meetings. Over-application and/or timing of application of fertilizers and/or manure could contribute to high nitrogen and phosphorus in tributaries and the mainstem. There is limited precision application occurring in the watershed, and it is not unusual to see manure being field applied to frozen ground.
CFOs, CAFOs and grazing animals	Increased nutrients could be coming from animal feed lots. Concern for animal feeding operations was voiced at Steering Committee meetings and Public Meetings. Run-off from feedlots, accidents, and application of manure on cropland could contribute to high nitrogen and phosphorus levels . Application of manure to frozen fields may contribute to high nitrogen and phosphorus levels. Livestock that have direct access to streams may contribute to high nitrogen and phosphorus levels.
Septic systems or straight pipes	Increased nitrogen and phosphorus could be coming from malfunctioning septic systems or straight pipes. Concern for failing septic systems and straight pipes was voiced at Steering Committee and Public Meetings. The town of Laketon does not have a wastewater treatment facility and is on the mainstem which may contribute to high nitrogen and phosphorus levels. 42% of households in Miami County have septic systems and 40% of households in Wabash County have septic systems.
Wetland loss; filled or drained	Suspected increase in nitrogen and phosphorus related to wetland loss throughout the watershed. Concern voiced at Steering Committee and Public Meetings. Wetland loss could contribute to high nitrogen and phosphorus levels.
Combined sewer overflow (CSOs)	Increased nitrogen and phosphorus could be coming from CSOs. Concern for CSOs was voiced at Public Meetings. Discharge of raw sewage from rain events causing a bypass of the treatment plant in North Manchester could contribute to high nitrogen and phosphorus levels.
Problem statement: High levels of nitrogen and phosphorus are present in the Watershed. Stakeholders expressed concern regarding high nitrogen and phosphorus levels at Steering Committee and Public Meetings. Water quality data confirms these concerns. Extensive tile drainage, conventional tillage, erosion from cropland, fertilizer and manure runoff, run-off from animal feed lots, failing septic systems, wetland loss, and CSO by-pass events are suspected sources of nitrogen and phosphorus.	

Potential water quality stressors, sources and causes of E. coli in tributaries and mainstem	
Potential Source	Basis/Evidence
Erosion from cropland	Increased sediment, carrying E. coli, could be coming from agricultural land use. Concern for agricultural land use contributing to high E. coli was voiced at Steering Committee and Public Meetings. 89% of land use within the Middle Eel River Watershed is agricultural and Miami and Wabash County have large percentages of row crops. Erosion from row crop agriculture could be contributing to high E. coli counts.
Manure Application	Increased E. coli levels could be coming from agricultural operations. Concern for agricultural land use contributing to increased E. coli counts was voiced at Steering Committee Meetings and Public Meetings. Over-application or improper timing of application of manure as fertilizer could contribute to high E. coli counts. Application of manure to frozen fields may contribute to high E. coli counts.
CFOs, CAFOs and grazing animals	Increased E. coli could be coming from animal feed lots. Concern for animal feeding operations was voiced at Steering Committee meetings and Public Meetings. Run-off and accidents could contribute to high E. coli counts. Livestock that have direct access to streams may contribute to high E. coli counts.
Failing septic systems or straight pipes	Increased E. coli could be coming from malfunctioning septic systems or straight pipes. Concern for failing septic systems and straight pipes was voiced at Steering Committee and Public Meetings. The town of Laketon does not have a wastewater treatment facility and is located on the mainstem which may contribute to high E. coli counts.
E. coli loading from combined sewer overflows (CSOs)	Concern for CSOs contributing to elevated E coli counts was voiced at Public Meetings. Discharge of raw sewage from rain events causing a bypass of the North Manchester water treatment plant could contribute to high E. coli counts.
Problem Statement: Elevated E. coli is a problem within the Middle Eel River Watershed. This has been confirmed by water quality data collected. All the sampling locations geometric mean concentrations were greater than the state standard for full body contact recreation. Suspected sources are failing septic systems, combined sewer overflows (CSOs), effluent from wastewater treatment facilities, illicit straight pipe discharges of sewage, and run-off from feed lots and row crop agricultural areas.	

Potential water quality stressors, sources and causes of excessive sediment in tributaries and mainstem	
Potential Source	Basis/Evidence
Erosion from cropland	Increased sediment could be coming from agricultural land use. Concern for agricultural land use contributing to high suspended sediment was voiced at Steering Committee and Public Meetings. 89% of land use within the Middle Eel River Watershed is agricultural. Miami County has 52% conventional tillage corn and 5% conventional tillage soybeans and Wabash County has 73% conventional tillage corn and 23% conventional tillage soybeans. Erosion from conventionally tilled row crop agriculture could be contributing to excessive sediment.
CFOs, CAFOs and grazing animals	Increased sediment could be coming from animal feed lots. Concern for animal feeding operations was voiced at Steering Committee meetings and Public Meetings. Erosion from livestock lots could contribute to high sedimentation. Livestock that have direct access to streams may contribute to excessive sediment from streambank erosion.
Hydrological changes affecting streamflow	Increased velocity may be causing excessive sediment. Tile drainage has altered the hydrology of the natural system resulting in increased flashiness of all the streams within the watershed. This flashiness, that causes an increase in velocity, may be contributing to excessive sedimentation.
Hydrologic modification: Filled or drained wetlands	Suspected increase in sediment related to wetland loss throughout the watershed. Concern was voiced at Steering Committee and Public Meetings regarding the loss of wetlands which may contribute to excessive sediment in the tributaries and the mainstem.
Problem Statement: There are very high levels of Total Suspended Solids within the Watershed. The Stakeholders expressed concern regarding excessive total suspended sediment at Steering Committee and Public Meetings. Water quality data confirms these concerns. Suspected sources are: conventional tillage, erosion from row crop agriculture, animal feed lots, ditching and dredging of streams and loss of wetlands that serve as filters.	

Potential water quality stressors, sources and causes of impaired biotic communities in tributaries and mainstem	
Potential Source	Basis/Evidence
Habitat modification: removal of riparian vegetation and bank modification/destabilization	Concern voiced at Steering and Public Meetings. Forested riparian buffers were virtually non-existent in many of the tributaries resulting in low QHEI scores. In many instances row crops are very close to the stream with no buffer. Ditch maintenance resulting in the removal of most of the vegetated riparian buffer is common within the watershed, decreasing the canopy, removing the buffering capability of the riparian area, and destroying natural aquatic habitats. Channel modifications are seen in almost of the tributaries of the watershed.
Hydrologic modification: Filled or drained wetlands	Concern was voiced at Steering Committee and Public Meetings about wetland loss that has occurred throughout the watershed. Hydric soils in the watershed indicate high wetland losses in the watershed. Loss of wetland services such as water filtering and slowing the flow, may have resulted in an impaired biotic community.
Problem Statement: There are impaired biotic communities and degraded habitats in the watershed. Concern for impaired biotic communities has been substantiated by the IBI and the QHEI. Sources could include land use changes within the riparian areas along the tributaries and mainstem, hydromodification within the Watershed, loss of wetlands and conventional tillage.	

Concern: Lack of Public Awareness	
Potential Source	Basis/Evidence
Public lacks understanding of their actions on water quality	Concern was voiced at Steering Committee meetings that the public lacks understanding of how they contribute to NPS pollution and lack the understanding of what a watershed is. Nonpoint source pollution (NPS) is everyone's problem and comes from all different types of land use.
Problem Statement: Lack of public awareness of nonpoint source pollution and understanding of the watershed concept is a problem in the Watershed. The Steering Committee believes the general public needs to better understand how and why their actions impact water quality.	